

PRELIMINARY DESIGN REPORT

PALMERSTON NORTH FREIGHT HUB - LIGHTING DESIGN

PREPARED FOR KIWIRAIL


28 July 2020 (updated February 2021)



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REVISION SCHEDULE

Rev No.	Date	Description	Signature or Typed Name (documentation on file)			
			Prepared by	Checked by	Reviewed by	Approved by
A	28/07/2020	FINAL	IC			
B	22/09/2020	FINAL - LAYOUT CHANGES	IC			
C	04/02/2021	FINAL – OBTRUSIVE LIGHTING CALCULATIONS ADDED	IC			

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1. Background

In conjunction with the proposed Regional Freight Hub (Freight Hub) north of Palmerston North, new lighting is required for the internal access roads, car parks and outdoor operational areas. The outdoor operational areas include the maintenance facilities, network serviced depot, log loading siding, tank siding, rail marshalling yard, container terminal and freight forwarding private sidings.

2. Scope

This report specifies the performance and light technical parameters (LTPs) of the lighting design required to achieve compliance with specific KiwiRail requirements as well as relevant AS/NZS standards.

Power supply requirements associated with the proposed lighting is excluded from this design report.

3. Applicable Lighting Levels

The standards applicable are:

AS/NZS 1158.3.1:~~2020~~ (Part 3.1) - Pedestrian area (Category P) lighting - Performance and design requirements

AS/NZS 4282:2019 - Control of the obtrusive effects of outdoor lighting

E-ST-EL-0131 - Traction and Electrical Standard

As requested by KiwiRail the lighting for the internal access roads and car parks has been designed in accordance with the relevant parts of AS/NZS 1158.3.1; and the outdoor operational areas have been designed in accordance with E-ST-EL-0131. ~~Spill light isolux lines have been provided (on the layout drawings) as guidance~~ Obtrusive lighting (spill light and glare) calculations were completed (for the closest residential buildings to the proposed Freight Hub) against the requirements of AS/NZS 4282.

3.1 Basis of Design – Internal Access Roads

Based on the selection criteria from Table 2.1 of AS/NZS 1158.3.1 the lighting subcategory PR5 was applied to the internal access roads. Refer highlighted portions of the table below.

Table 2.1 from AS/NZS 1158.3.1:

1	2	3	4	5	6
Type of road or pathway		Selection criteria ^{a,b}			Applicable lighting subcategory ^{c,d}
General description	Basic operating characteristics	Pedestrian/cycle activity	Fear of crime	Need to enhance amenity	
Collector roads or non-arterial roads which collect and distribute traffic in an area, as well as serving abutting properties	Mixed vehicle and pedestrian traffic	N/A	High	N/A	PR1
		High	Medium	High	PR2
		Medium	Low	Medium	PR3 ^f or PR4 ^f
		Low	Low	Low	PR5
Local roads or streets used primarily for access to abutting properties, including residential commercial and industrial precincts		N/A	High	N/A	PR1
		High	Medium	High	PR2
		Medium	Low	Medium	PR3 ^f or PR4 ^f
		Low	Low	Low	PR5
Common area, forecourts of cluster housing		N/A	N/A	N/A	PR6 ^e
		N/A	High	N/A	PR1
		High	Medium	High	PR2
		Medium	Low	Medium	PR3 ^f or PR4 ^f
		Low	Low	Low	PR5

The lighting of the internal roads was designed to achieve the PR5 requirements from Table 3.3 of AS/NZS 1158.3.1. Refer highlighted portions of the table below:

1	2	3	4
Lighting subcategory	Light technical parameters (LTP)		
	Average horizontal illuminance ^{a,b} (\bar{E}_h) lx	Point horizontal illuminance ^{a,b} (E_{ph}) lx	Illuminance (horizontal) uniformity ^c Cat. P (U_{E2})
PR1	7	2	8
PR2	3.5	0.7	8
PR3 ^e	1.75	0.3	8
PR4 ^{d,e}	1.3	0.22	8
PR5 ^{d,e}	0.85	0.14	10
PR6 ^d	0.7	0.07	10

3.2 Basis of Design - Car Parks

Based on the selection criteria from Table 2.5 of AS/NZS 1158.3.1 the lighting subcategory PC3 was applied to the internal car parks. Refer highlighted portions of the table below.

Table 2.5 from AS/NZS 1158.3.1:

TABLE 2.5 LIGHTING SUBCATEGORIES FOR OUTDOOR CAR PARKS (INCLUDING ROOF-TOP CAR PARKS)			
1	2	3	4
Type of area	Selection criteria ^{a,c}		
	Night time vehicle and/or pedestrian movements	Fear of crime	Applicable lighting subcategory ^b
Parking spaces, aisles and circulation roadways	High	High	PC1
	Medium	Medium	PC2
	Low	Low	PC3
Designated parking spaces specifically intended for people with disabilities	N/A	N/A	PCD
For any designated areas for pedestrians to cross	N/A	N/A	PCX

The lighting of the internal car parks was designed to achieve the PC3 requirements from Table 3.7 of AS/NZS 1158.3.1. Refer highlighted portions of the table below:

TABLE 3.7 VALUES OF LIGHT TECHNICAL PARAMETERS FOR OUTDOOR CAR PARKS (INCLUDING ROOF-TOP CAR PARKS)				
1	2	3	4	5
Lighting subcategory	Light technical parameters (LTP)			
	Average horizontal illuminance ^{a,b} (\bar{E}_h)	Point horizontal illuminance ^{a,b} (E_{Ph})	Illuminance (horizontal) uniformity ^c Cat. P (U_{E2})	Point vertical illuminance ^{a,b} (E_{Pv})
	lx	lx		lx
PC1	14	3	8	3
PC2	7	1.5	8	1
PC3	3.5	0.7	8	—
PCD ^d	—	≥ 14 and $\geq (\bar{E}_h)^d$	—	—
PCX ^e	21	5	8	—

3.3 Basis of Design - Outdoor Operational Areas

The lighting of the outdoor operational areas was designed to achieve the applicable requirements from Table 6.1 of E-ST-EL-0131. Refer highlighted portions of the table below:

Table 6.1 Lighting levels and quality

Type of area	E _m	U _o	GR _L	R _a	U _d
Railway Marshalling Yards - Anywhere shunting operations are carried out	≥ 10 lux	≤ 0.40	≤ 50	≥ 20	≥ 1/5
Freight Track, short duration operations - The portion of a rail siding where loading and unloading does not occur. Rail movements are infrequent.	≥ 10 lux	≤ 0.25	≤ 50	≥ 20	≥ 1/8
Freight Track, continuous operations - The portion of a rail freight yard where loading and unloading does not occur. Rail movements are frequent. Road traffic and pedestrians are likely to be present.	≥ 20 lux	≤ 0.40	≤ 50	≥ 20	≥ 1/5
Railway Yards Handling Areas - Anywhere that wagons are being loaded with cranes or forklifts. This includes most of the main freight sidings and the Interisland Line terminal areas where wagons are loaded/unloaded	≥ 30 lux	≤ 0.40	≤ 50	≥ 20	≥ 1/5

3.4 Basis of Design - Obtrusive Lighting

1-Lux spill light isolux contour lines have been provided (on the layout drawings) to identify any residential

properties that may be adversely affected by the Freight Hub lighting.

The applicable levels of maximum obtrusive light (spill light and glare) is and sky glow (Upward Waste Light Ratio - UWLR) are based on what particular environment zone the residential properties are within. Zone A2 was selected based on low district brightness associated with sparsely inhabited rural / semi-rural areas. Refer highlighted portions of table below.

Table 3.1 from AS/NZS 4282 - Environmental Zones:

TABLE 3.1 ENVIRONMENTAL ZONES		
Zones	Description	Examples
A0	Intrinsically dark	UNESCO Starlight Reserve. IDA Dark Sky Parks. Major optical observatories No road lighting - unless specifically required by the road controlling authority
A1	Dark	Relatively uninhabited rural areas No road lighting - unless specifically required by the road controlling authority
A2	Low district brightness	Sparsely inhabited rural and semi-rural areas
A3	Medium district brightness	Suburban areas in towns and cities
A4	High district brightness	Town and city centres and other commercial areas Residential areas abutting commercial areas

Spill Light:

The maximum level of spill light (vertical illuminance - Lux) and UWLR for Zone A2, during curfew, is provided in the following table:

TABLE 3.2 MAXIMUM VALUES OF LIGHT TECHNICAL PARAMETERS					
Zones	Vertical illuminance levels (E_v) lx		Threshold increment (TI)		Sky glow
	Non-curfew	Curfew	%	Default adaptation level (L_{ad})	Upward light ratio
A0	See Note 1	0	N/A	N/A	0
A1	2	0.1	N/A	N/A	0
A2	5	1	20%	0.2	0.01
A3	10	2	20%	1	0.02
A4	25	5	20%	5	0.03
TV	See Table 3.4	N/A	20%	10	0.08

change

TABLE 3.3
MAXIMUM LUMINOUS INTENSITIES PER LUMINAIRE

Zone	Luminous intensity (<i>I</i>), cd		
	Non-curfew L1	Non-curfew L2	Curfew
A0	See Note	See Note	0
A1	2 500	5 000	500
A2	7 500	12 500	1 000
A3	12 500	25 000	2 500
A4	25 000	50 000	2 500
TV	100 000	150 000	0

NOTE: For A0, *I* shall be as close to zero as practicable without impacting safety considerations.

Glare:

The maximum level of glare (maximum luminous intensity per luminaire - cd) for Zone A2, during curfew, is provided in table above.

4. Design Modelling Results

In accordance with AS/NZS 1158.3.1 and E-ST-EL-0131 illuminance and uniformity calculations were carried out for the internal access roads, car parks and outdoor operational areas.

In accordance with AS/NZS 4282 obtrusive lighting calculations have been completed to identify any residential properties that may be adversely affected by the proposed Freight Hub lighting.

~~Spill light or glare calculations were not carried out for any particular residential buildings, however 1 Lux isolux contour lines were provided (on the layout drawings) to help identify any residential properties that may be adversely affected by the Freight Hub lighting. Detailed calculations may be required in the future if deemed necessary.~~

All calculations were completed using the lighting software program AGI32, version 2.31, supplied by Lighting Analysts, Inc.

The photometric files (used in the illuminance and luminance calculations) were provided by the luminaire supplier ENERGYLIGHT Ltd.

The results are shown in the drawings appended in Appendix C.

4.1 Luminaire and Mounting Parameters

Refer to Appendix A for details of the new luminaires and Appendix B for details of the new lighting poles. The new lighting poles shall be located where shown on the layout drawings.

The design results were achieved using a maintenance factor of 0.8, and the following luminaire and mounting parameters:

Type A

Luminaire: AEC Italo 1 (STAN0 4000K 350mA 3M) 27W (3320 lm) LED.

Mounting: 7.3m mounting height with 0° tilt on new ground planted tapered octagonal steel lighting pole complete with 0.9m curved outreach arm.

Type B

Luminaire: AEC Italo 1 (STAN0 4000K 525mA 4M) 51W (6020 lm) LED.

Mounting: 7.3m mounting height with 5° tilt on new ground planted tapered octagonal steel lighting pole complete with 0.9m curved outreach arm.

Type C

Luminaire: AEC Italo 1 (S05 4000K 350mA 2M) 27W (3400 lm) LED.

Mounting: 7.3m mounting height with 0° tilt on new ground planted tapered octagonal steel lighting pole complete with 0.9m curved outreach arm.

Type D

Luminaire: AEC Italo 1 (S05 4000K 350mA 2M) 27W (3400 lm) LED (2 off).

Mounting: 7.3m mounting height with 0° tilt on new ground planted tapered octagonal steel lighting pole complete with double 0.9m curved outreach arms.

Type E

Luminaire: AEC Italo 1 (S05 4000K 350mA 3M) 39W (4970 lm) LED.

Mounting: 7.3m mounting height with 0° tilt on new ground planted tapered octagonal steel lighting pole complete with 0.9m curved outreach arm.

Type F

Luminaire: AEC Italo 1 (S05 4000K 350mA 3M) 39W (4970 lm) LED (2 off).

Mounting: 7.3m mounting height with 0° tilt on new ground planted tapered octagonal steel lighting pole complete with double 0.9m curved outreach arms.

Type G

Luminaire: EWO R4 (Gen 3 EP09 Left / Right Optic 4000K 1800mA) 1523W (182874 lm) LED Floodlight.

Mounting: 22.078m mounting height with 5° tilt on new 22.4m (nominal) flange based tapered octagonal steel flood lighting pole complete with 0.6m horizontal cross arm. Luminaire mounted to front face of cross arm using proprietary over-frame bracket.

Type H

Luminaire: EWO R4 (Gen 3 EP09 Left / Right Optic 4000K 1800mA) 1523W (182874 lm) LED Floodlight (2 per pole).

Mounting: 22.078m mounting height with 5° tilt on new 22.4m (nominal) flange based tapered octagonal steel flood lighting pole complete with 0.6m horizontal cross arm. Each luminaire mounted to front face of cross arm, using proprietary over-frame brackets, to form opposing (180°) aiming directions.

Type J

Luminaire: EWO R4 (Gen 3 EP09 Left / Right Optic 4000K 1800mA) 1523W (182874 lm) LED Floodlight.

Mounting: 22.078m mounting height with 10° tilt on new 22.4m (nominal) flange based tapered octagonal steel flood lighting pole complete with 0.6m horizontal cross arm. Luminaire mounted to front face of cross arm using proprietary over-frame bracket.

Type K

Luminaire: EWO R4 (Gen 3 EP09 Left / Right Optic 4000K 1800mA) 1523W (182874 lm) LED Floodlight (2 per pole).

Mounting: 22.078m mounting height with 10° tilt on new 22.4m (nominal) flange based tapered octagonal steel flood lighting pole complete with 0.6m horizontal cross arm. Each luminaire mounted to front face of cross arm, using proprietary over-frame brackets, to form opposing (180°) aiming directions.

Type L

Luminaire: EWO R4 (Gen 3 EP09 Left / Right Optic 4000K 1800mA) 1523W (182874 lm) LED Floodlight.

Mounting: 12m mounting height with 20° tilt secured to front face of building using propriety stirrup bracket.

4.2 Maintenance Factor - Italo Luminaires

A design maintenance factor (MF) is used in the calculations to account for the combined light losses resulting from depreciation in the LED's lumen output and accumulation of dirt on the luminaire.

The MF is calculated as the product of the following depreciation factors:

- (a) *Luminaire Maintenance Factor (LMF)*: The factor selected from table B.1 of BS 5489-1 which considers the environmental zone, mounting height and cleaning interval. An environmental zone of E3/E4 was selected (corresponding to moderate/high ambient luminance areas), the mounting heights are not more than 6m and a maximum luminaire cleaning interval of 72 months (6 years or 25,200 hours operation) was selected resulting in an LMF of 0.84.

Table B.1 Luminaire maintenance factors

Environmental zone	Mounting height	Maintenance factor					
		Cleaning frequency 12 months	Cleaning frequency 24 months	Cleaning frequency 36 months	Cleaning frequency 48 months	Cleaning frequency 60 months	Cleaning frequency 72 months
E1/E2	≤6 m	0.96	0.96	0.95	0.94	0.93	0.92
E1/E2	>6 m	0.96	0.96	0.95	0.94	0.93	0.92
E3/E4	≤6 m	0.94	0.92	0.90	0.88	0.86	0.84
E3/E4	>6 m	0.96	0.96	0.95	0.94	0.93	0.92

- (b) *Light Source Lumen Depreciation Factor (LLD)*: The amount of light (lumen output) available at the end of a nominated operating period, as a proportion of the initial lumen output (when the LED was new), expressed as a decimal fraction. An LLD of 0.98 was provided by the LED supplier.
- (c) *Luminaire Survival Factor (LSF)*: This is the expected amount of failures after 85,000 hours of operation (including electronic components, drivers, lenses, premature failures or mechanical failure). An LSF of 0.99 was provided by the LED supplier.

Table B.1 of BS 5489-1 and the manufacturer supplied data has provided in an LMF of 0.92, an LLD of 0.92 and an LSF of 0.99.

$$MF = LMF \times LLD \times LSF$$

$$MF = 0.84 \times 0.98 \times 0.99$$

$$MF = 0.815$$

A design maintenance factor of 0.8 was applied to the calculations.

It is important to note that the design results are based on a maintenance interval (luminaire cleaning cycle) of 6 years. At the end of 6 years the lighting should still comply with the road lighting standards (AS/NZS 1158), but the luminaires will require cleaning before the performance of the lighting installation degrades below the requirements of the standards. If the luminaires are not routinely cleaned the gradual accumulation of dirt will eventually compromise the optical performance of the installation.

4.3 Maintenance Factor - EWO R4 LED Flood Lights

A design maintenance factor (MF) is used in the calculations to account for the combined light losses resulting from depreciation in the LED's lumen output and accumulation of dirt on the luminaire.

The MF is calculated as the product of the following depreciation factors:

- (d) *Luminaire Maintenance Factor (LMF)*: The amount of light (lumen output) available at the end of a nominated period (cleaning interval) where the output has fallen due to the accumulation of dirt. An LMF of 0.92 was provided by the LED supplier based on an 8 year cleaning cycle, glass visor and PMMA lens.
- (e) *Light Source Lumen Depreciation Factor (LLD)*: The amount of light (lumen output) available at the end of a nominated operating period as a proportion of the initial lumen output (when the LED was new). An LLD of 0.99 was provided by the LED supplier based on 85,000 hours of operation and an ambient temperature of 25°C.
- (f) *Luminaire Survival Factor (LSF)*: This is the expected amount of failures after 85,000 hours of operation (including electronic components, drivers, lenses, premature failures or mechanical failure). An LSF of 1.0 was provided by the LED supplier based on no reported failures.

$$MF = LMF \times LLD \times LSF$$

$$MF = 0.92 \times 0.99 \times 1.0$$

$$MF = 0.91$$

A conservative design maintenance factor of 0.8 was applied to the calculations.

It is important to note that the design results are based on a maintenance interval (luminaire cleaning cycle) of 8 years. At the end of 8 years the lighting should still achieve the maintained average illuminance, but the luminaires will require cleaning before the output of the lighting installation falls below current design levels. If the luminaires are not routinely cleaned the gradual accumulation of dirt will eventually compromise the optical performance of the installation.

4.4 Illuminance Design Results – Internal Access Roads and Car Parks

An illuminance based design was carried out to determine the average horizontal illuminance (E_h), point horizontal illuminance (E_{ph}) and horizontal uniformity (U_{e2}) using the lighting software program AGI32, version 2.31, supplied by Lighting Analysts, Inc.

The applicable design areas are the internal roads and parking spaces.

Design area boundaries and calculation points were established in accordance with AS/NZS 1158.2. Refer to the design results below:

Label	Calc Type	Units	Avg	Min	Max/Avg	Description
Access Roads	Illuminance	Lux	2.2	0.14	9.7	Cat PR5 - 0.85 Lux (Avg), 0.14 Lux (Min) and Uniformity (Max/Avg) of 10 (Max)
Container Terminal Car Park 1	Illuminance	Lux	3.8	0.8	3.1	Cat PC3 - 3.5 Lux (Avg), 0.7 Lux (Min) and Uniformity (Max/Avg) of 8 (Max)
Container Terminal Car Park 2	Illuminance	Lux	4.8	0.8	3.3	Cat PC3 - 3.5 Lux (Avg), 0.7 Lux (Min) and Uniformity (Max/Avg) of 8 (Max)
Container Terminal Car Park 3	Illuminance	Lux	3.8	0.9	4.0	Cat PC3 - 3.5 Lux (Avg), 0.7 Lux (Min) and Uniformity (Max/Avg) of 8 (Max)
Freight Forwarding Car Park	Illuminance	Lux	4.6	0.8	4.9	Cat PC3 - 3.5 Lux (Avg), 0.7 Lux (Min) and Uniformity (Max/Avg) of 8 (Max)
Network Services Car Park 1	Illuminance	Lux	3.9	0.9	3.1	Cat PC3 - 3.5 Lux (Avg), 0.7 Lux (Min) and Uniformity (Max/Avg) of 8 (Max)
Network Services Car Park 2	Illuminance	Lux	3.6	0.9	3.5	Cat PC3 - 3.5 Lux (Avg), 0.7 Lux (Min) and Uniformity (Max/Avg) of 8 (Max)
Network Services Car Park 3	Illuminance	Lux	3.5	0.7	3.4	Cat PC3 - 3.5 Lux (Avg), 0.7 Lux (Min) and Uniformity (Max/Avg) of 8 (Max)
Network Services Car Park 4	Illuminance	Lux	5.3	0.9	3.4	Cat PC3 - 3.5 Lux (Avg), 0.7 Lux (Min) and Uniformity (Max/Avg) of 8 (Max)
Network Services Car Park 5	Illuminance	Lux	4.6	0.8	3.8	Cat PC3 - 3.5 Lux (Avg), 0.7 Lux (Min) and Uniformity (Max/Avg) of 8 (Max)

4.5 Illuminance Design Results - Outdoor Operational Areas

An illuminance based design was carried out to determine the average horizontal illuminance (E_m), illuminance uniformity (U_o) and illuminance diversity (U_d) using the lighting software program AGI32, version 2.31, supplied by Lighting Analysts, Inc.

The applicable design areas include the network services depot, log loading siding, tank siding, rail marshalling yard (including maintenance facilities and general areas), container terminal and freight forwarding private sidings.

Design area boundaries and calculation grid points were established in accordance with E-ST-EL-0131. Refer to the design results below:

Illuminance Calculation Summary Table - KiwiRail Traction and Electrical Standard E-ST-EL-0131						
Label	CalcType	Units	Avg	Uo (Min/Avg)	Ud (Min/Max)	Design Requirements
Container Terminal Handling Area	Illuminance	Lux	39.4	0.4	0.2	Table 6.1 - Avg \geq 30 Lux, $U_o \geq$ 0.4 and $U_d \geq$ 0.2
Freight Forwarding Area 1	Illuminance	Lux	33.2	0.4	0.2	Table 6.1 - Avg \geq 30 Lux, $U_o \geq$ 0.4 and $U_d \geq$ 0.2
Freight Forwarding Area 2	Illuminance	Lux	32.2	0.4	0.3	Table 6.1 - Avg \geq 30 Lux, $U_o \geq$ 0.4 and $U_d \geq$ 0.2
Log Loading Area and Tank Siding	Illuminance	Lux	37.1	0.4	0.2	Table 6.1 - Avg \geq 30 Lux, $U_o \geq$ 0.4 and $U_d \geq$ 0.2
Network Services Handling Areas	Illuminance	Lux	37.2	0.4	0.3	Table 6.1 - Avg \geq 30 Lux, $U_o \geq$ 0.4 and $U_d \geq$ 0.2
Railway Marshalling Areas	Illuminance	Lux	31.6	0.4	0.2	Table 6.1 - Avg \geq 20 Lux, $U_o \geq$ 0.4 and $U_d \geq$ 0.2

4.6 Spill Light

4.7.14.6 Obtrusive Lighting Calculation Results

4.7.14.6.1 Spill Light

According to AS/NZS 4282:2019, the Freight Hub is within zone A2 where the vertical illumination on the walls of residential buildings containing windows is not permitted to exceed 1 Lux. No specific design to check individual properties has been completed, however the 1 Lux horizontal isolux contour line (originating from the Freight Hub) has been plotted on the layout drawings to provide a visual guide.

~~During detailed design specific spill light and glare calculations can be completed for individual residential properties if deemed necessary.~~

~~Spill light calculations were carried out to determine the maximum point vertical illuminance (Lux) on the front faces of residential buildings in close proximity of the proposed Freight Hub. The existing trees and vegetation (between the properties and proposed Freight Hub) were not considered therefore the actual spill light should be less than the results indicate.~~

~~Refer to the design results below:~~

~~**North East Properties:**~~

SPILL LIGHT CALCULATION RESULTS - NORTH EAST PROPERTIES

Maximum Vertical Illuminance of 1 Lux (Zone A2 Curfew Hours)

Location	Maximum Calculated Value	Complies (Y/N)
22A Clevely Line	0.4	Y
41A Clevely Line	0.3	Y
41B Clevely Line	0.3	Y
1 Nathan Place	0.3	Y
2 Nathan Place	0.4	Y
3 Nathan Place	0.4	Y
4 Nathan Place	0.4	Y
5 Nathan Place	0.4	Y
6 Nathan Place	0.5	Y
7 Nathan Place	0.6	Y
27 Parrs Road	0.4	Y
55D Parrs Road	0.2	Y
58 Parrs Road	0.3	Y
59 Parrs Road	0.2	Y
9 Sangsters Road	0.4	Y
11 Sangsters Road	0.2	Y
15 Sangsters Road	0.3	Y
25 Sangsters Road	0.3	Y
43 Sangsters Road	0.7	Y
819 Stoney Creek Road	0.4	Y
821 Stoney Creek Road	0.7	Y

New

South East and South West Properties:

SPILL LIGHT CALCULATION RESULTS - SOUTH EAST AND SOUTH WEST PROPERTIES

Maximum Vertical Illuminance of 1 Lux (Zone A2 Curfew Hours)

Location	Maximum Calculated Value	Complies (Y/N)
163 Clevely Line	0.0	Y
422 Railway Road	1.0	Y
761 Roberts Line	0.3	Y
771 Roberts Line	0.4	Y
787 Roberts Line	0.0	Y
803 Roberts Line	0.0	Y
814 Roberts Line	0.0	Y
824 Roberts Line	0.0	Y
824A Roberts Line	0.0	Y
73 Sangsters Road	0.8	Y
91 Sangsters Road	0.7	Y
95 Sangsters Road	0.8	Y

new

428 Tutaki Road	0.2	Y
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North West Properties:

SPILL LIGHT CALCULATION RESULTS - NORTH WEST PROPERTIES		
Maximum Vertical Illuminance of 1 Lux (Zone A2 Curfew Hours)		
Location	Maximum Calculated Value	Complies (Y/N)
1 Maple Street	0.3	Y
1A Maple Street	0.3	Y
3 Maple Street	0.3	Y
5 Maple Street	0.3	Y
7 Maple Street	0.3	Y
7A Maple Street	0.3	Y
9 Maple Street	0.3	Y
9A Maple Street	0.4	Y
11 Maple Street	0.3	Y
11A Maple Street	0.4	Y
13 Maple Street	0.4	Y
15 Maple Street	0.4	Y
17 Maple Street	0.5	Y
19 Maple Street	0.4	Y
21 Maple Street	0.4	Y
57 Maple Street	0.2	Y
241 Te Ngaio Road	0.1	Y
242 Te Ngaio Road	0.1	Y
245 Te Ngaio Road	0.1	Y

New

The calculations indicate that spill light will not be an issue as the values are under the Zone A2 limits for curfew hours.

4.6.2 Glare

Glare calculations were carried out to determine the maximum luminous intensity (cd) per luminaire on the front faces of residential buildings in close proximity of the proposed Freight Hub. The existing trees and vegetation (between the properties and proposed Freight Hub) were included in the calculations using the standard object library within the AGi32 software. Note that using the AGi32 tree objects (from the standard library) is only an approximation of the likely effects that the existing trees and vegetation may have on the calculation results.

Refer to the design results below:

North East Properties:

GLARE CALCULATION RESULTS - NORTH EAST PROPERTIES		
Maximum Luminous Intensity of 1,000 cd (Zone A2 Curfew Hours)		
Location	Maximum Calculated Value	Complies (Y/N)

New

22A Clevely Line	25,243	N
41A Clevely Line	4,374	N
41B Clevely Line	2,295	N
1 Nathan Place	60,501	N
2 Nathan Place	61,821	N
3 Nathan Place	63,066	N
4 Nathan Place	64,085	N
5 Nathan Place	64,811	N
6 Nathan Place	67,598	N
7 Nathan Place	68,357	N
27 Parrs Road	2,089	N
55D Parrs Road	4,492	N
58 Parrs Road	1,868	N
59 Parrs Road	2,188	N
9 Sangsters Road	2,483	N
11 Sangsters Road	1,801	N
15 Sangsters Road	2,003	N
25 Sangsters Road	2,076	N
43 Sangsters Road	12,922	N
819 Stoney Creek Road	55,602	N
821 Stoney Creek Road	63,129	N

South East and South West Properties:

SPILL LIGHT CALCULATION RESULTS - SOUTH EAST AND SOUTH WEST PROPERTIES		
Maximum Luminous Intensity of 1,000 cd (Zone A2 Curfew Hours)		
Location	Maximum Calculated Value	Complies (Y/N)
163 Clevely Line	18,239	N
422 Railway Road	49,079	N
761 Roberts Line	3,346	N
771 Roberts Line	31,745	N
787 Roberts Line	2,627	N
803 Roberts Line	2,451	N
814 Roberts Line	226	Y
824 Roberts Line	323	Y
824A Roberts Line	453	Y
73 Sangsters Road	56,094	N
91 Sangsters Road	52,377	N
95 Sangsters Road	52,200	N
428 Tutaki Road	7,594	N

New



North West Properties:

SPILL LIGHT CALCULATION RESULTS - NORTH WEST PROPERTIES		
Maximum Luminous Intensity of 1,000 cd (Zone A2 Curfew Hours)		
Location	Maximum Calculated Value	Complies (Y/N)
1 Maple Street	59,589	N
1A Maple Street	60,476	N
3 Maple Street	61,053	N
5 Maple Street	61,532	N
7 Maple Street	62,340	N
7A Maple Street	62,516	N
9 Maple Street	63,348	N
9A Maple Street	61,836	N
11 Maple Street	63,919	N
11A Maple Street	62,136	N
13 Maple Street	62,747	N
15 Maple Street	61,052	N
17 Maple Street	60,723	N
19 Maple Street	56,636	N
21 Maple Street	54,988	N
57 Maple Street	22,251	N
241 Te Ngaio Road	3,824	N
242 Te Ngaio Road	1,932	N
245 Te Ngaio Road	3,970	N

New



The results indicate that the amount of glare will be high if the current design is adopted.

To mitigate the glare the following measures can be adopted during detailed design:

- Use proprietary glare shields (rear, sides and/or front as required).
- Adjust luminaire mounting parameters (orientation, aiming angles and/or tilts as required).
- Select lower output luminaires, however this may require additional poles.
- Select alternative luminaires from other supplier(s).

4.6.3 Sky Glow (UWLR)

The UWLR was calculated for the propose Freight Hub site for all luminaires.

Refer to the design results below:

UWLR Area Summary	
Label	UWLR
LPDArea_1	0.003

The calculations indicate that the calculated UWLR of 0.003 is well below the Zone A2 maximum limit of 0.01.

5. Flood Lighting Poles

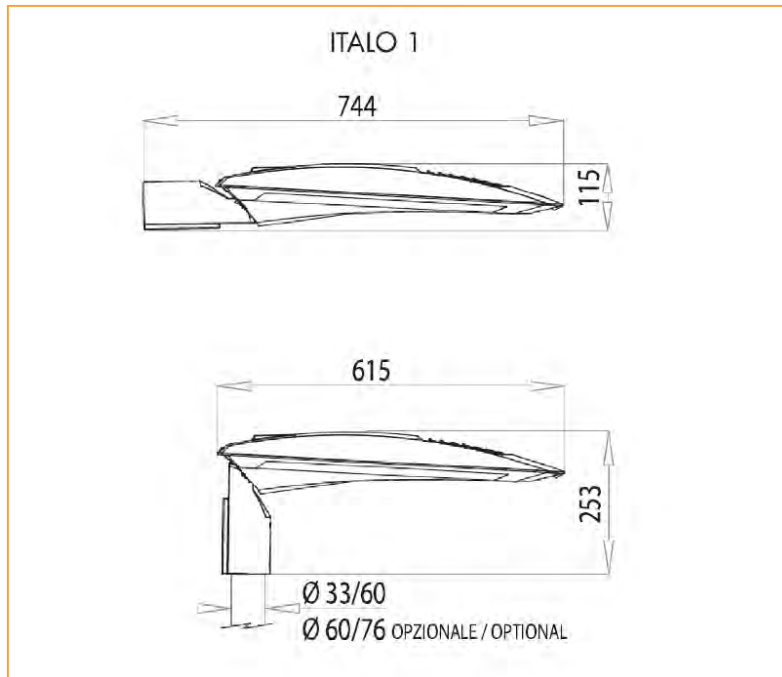
All new internal access road / car parking poles shall be Spunlite Subdivisional (or equal) hot dip galvanised tapered octagonal steel ground planted poles complete with curved outreach arms.

The new outdoor operational area poles shall be Spunlite (or equal) 22.4m flange based general purpose flood lighting poles complete with 0.6m long cross arms.

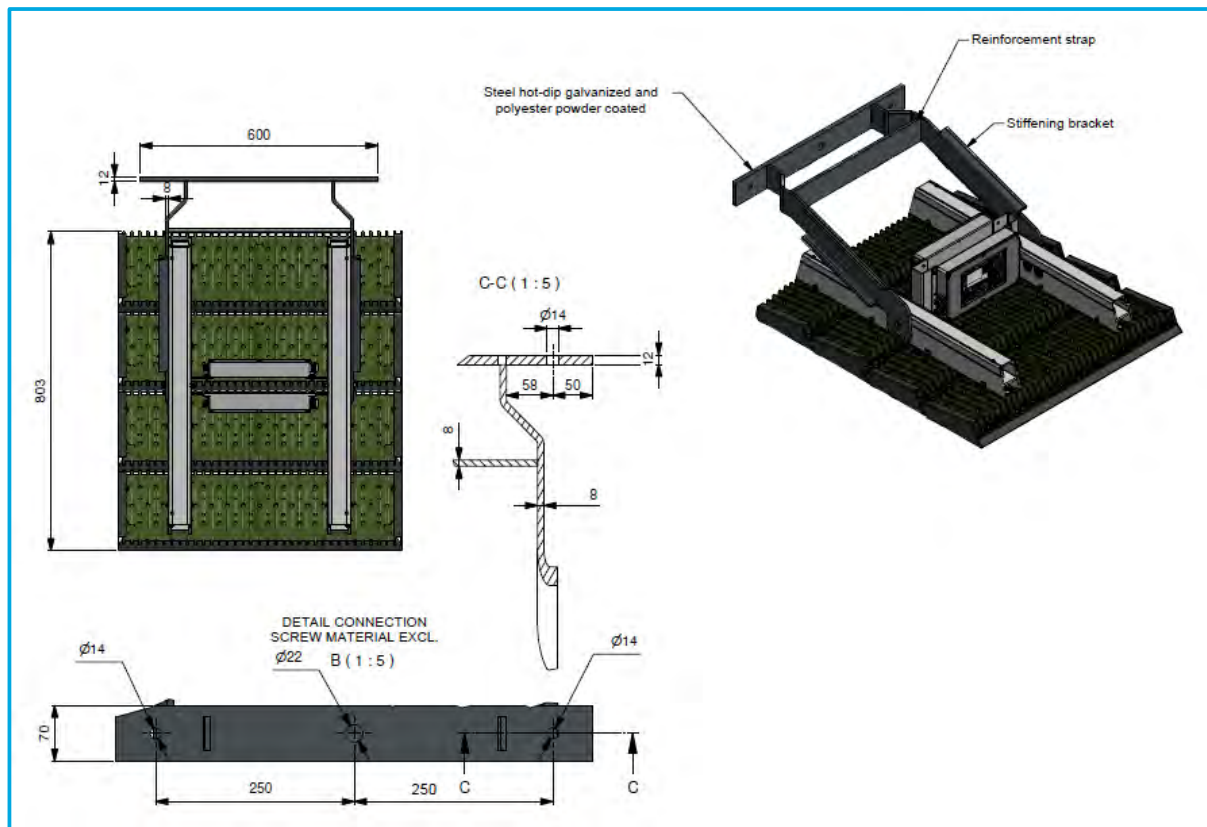
Refer to Appendix B for typical lighting pole details.

Appendix A LED Floodlight Luminaire Details

A.1 AEC Italo 1 Luminaire

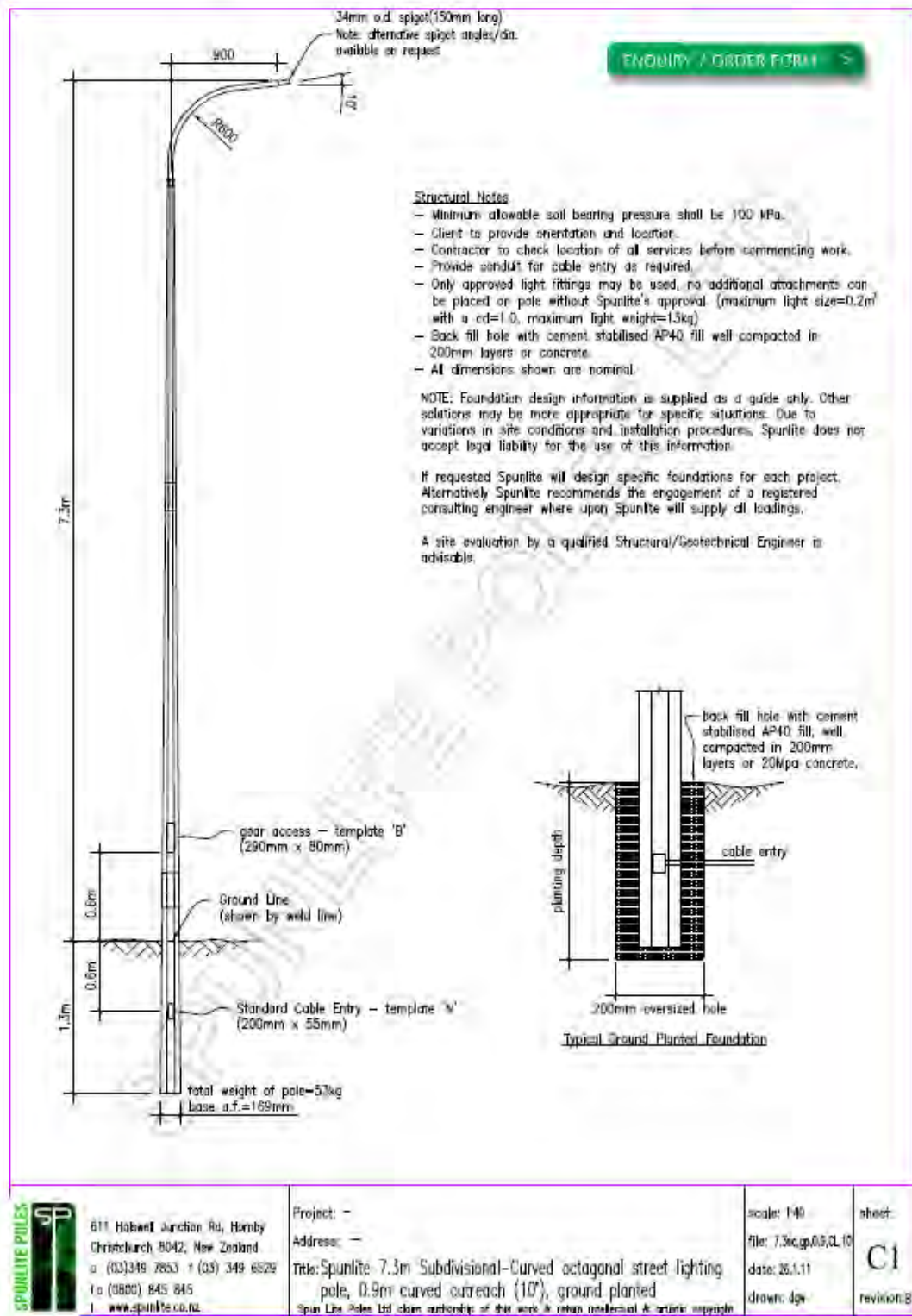


A.2 EWO R4 LED Floodlight

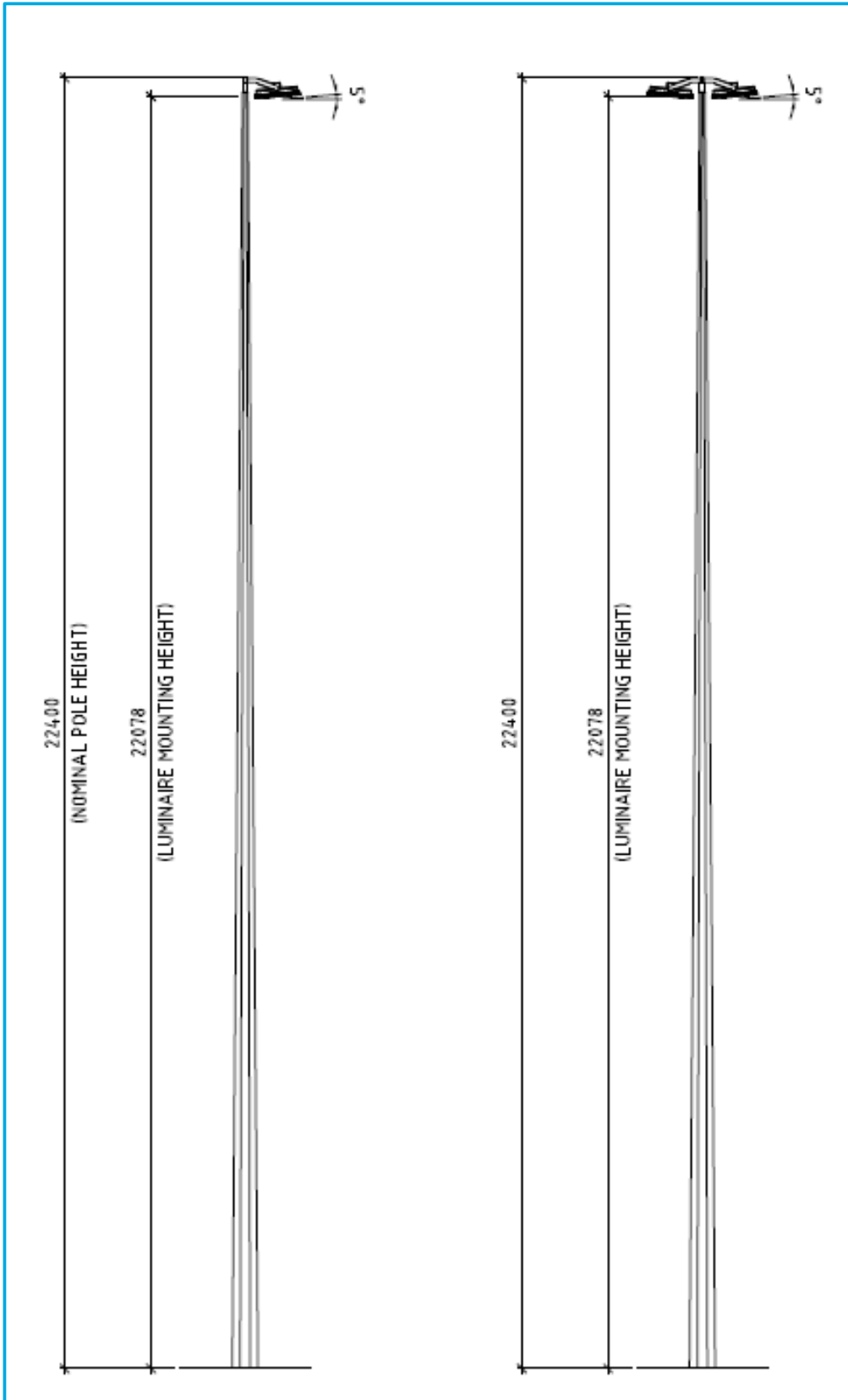


Appendix B Lighting Pole Details

B.1 Spunlite 7.3m Subdivisional Lighting Pole



B.2 Spunlite 22.4m Flange Based Flood Lighting Pole



Appendix C Drawings

Dunedin

Level 3 John Wickliffe House, 265 Princes Street
Dunedin 9016
PO Box 13-052, Armagh
Christchurch 8141
Tel +64 3 477 0885
Fax +64 3 477 0616


Please visit www.stantec.com to learn more about how
Stantec design with community in mind.



LUMINAIRE AND POLE LIST


TYPE	LED LUMINAIRE DESCRIPTION	POLE / MOUNTING DESCRIPTION	MOUNTING HEIGHT	OUTREACH ARM / BRACKET MOUNTING DETAILS	TILT ANGLE	LUMINAIRE QTY
A	AEC ITALO 1 (STAN0 4000K 350mA 3M) 27W LED	SPUNLITE SUBDIVISIONAL GP LIGHTING POLE C/W SINGLE ARM	7.3m	0.9M SINGLE CURVED OUTREACH ARM	0	123
B	AEC ITALO 1 (STAN0 4000K 525mA 4M) 51W LED	SPUNLITE SUBDIVISIONAL GP LIGHTING POLE C/W SINGLE ARM	7.3m	0.9M SINGLE CURVED OUTREACH ARM	5	3
C	AEC ITALO 1 (S05 4000K 350mA 2M) 27W LED	SPUNLITE SUBDIVISIONAL GP LIGHTING POLE C/W SINGLE ARM	7.3m	0.9M SINGLE CURVED OUTREACH ARM	0	27
D	AEC ITALO 1 (S05 4000K 350mA 2M) 27W LED (2 PER POLE)	SPUNLITE SUBDIVISIONAL GP LIGHTING POLE C/W DOUBLE ARMS	7.3m	0.9M DOUBLE CURVED OUTREACH ARMS	0	4
E	AEC ITALO 1 (S05 4000K 350mA 3M) 39W LED	SPUNLITE SUBDIVISIONAL GP LIGHTING POLE C/W SINGLE ARM	7.3m	0.9M SINGLE CURVED OUTREACH ARM	0	16
F	AEC ITALO 1 (S05 4000K 350mA 3M) 39W LED (2 PER POLE)	SPUNLITE SUBDIVISIONAL GP LIGHTING POLE C/W DOUBLE ARMS	7.3m	0.9M DOUBLE CURVED OUTREACH ARMS	0	4
G	EWO R4 (GEN 3 EP09 LR OPTIC 4000K 1800mA) 1523W	SPUNLITE 22.4m FLB FLOOD LIGHTING POLE C/W 0.6m CROSS ARM	22.078m	PROPRIETARY OVER-FRAME BRACKET MOUNTED TO POLE CROSS ARM (VERTICAL FACE)	5	24
H	EWO R4 (GEN 3 EP09 LR OPTIC 4000K 1800mA) 1523W (2 PER POLE)	SPUNLITE 22.4m FLB FLOOD LIGHTING POLE C/W 0.6m CROSS ARM	22.078m	PROPRIETARY OVER-FRAME BRACKET MOUNTED TO POLE CROSS ARM (VERTICAL FACE)	5	82
J	EWO R4 (GEN 3 EP09 LR OPTIC 4000K 1800mA) 1523W	SPUNLITE 22.4m FLB FLOOD LIGHTING POLE C/W 0.6m CROSS ARM	22.078m	PROPRIETARY OVER-FRAME BRACKET MOUNTED TO POLE CROSS ARM (VERTICAL FACE)	10	25
K	EWO R4 (GEN 3 EP09 LR OPTIC 4000K 1800mA) 1523W (2 PER POLE)	SPUNLITE 22.4m FLB FLOOD LIGHTING POLE C/W 0.6m CROSS ARM	22.078m	PROPRIETARY OVER-FRAME BRACKET MOUNTED TO POLE CROSS ARM (VERTICAL FACE)	10	26
L	EWO R4 (GEN 3 EP09 LR OPTIC 4000K 1800mA) 1523W	BUILDING MOUNTED	12m	PROPRIETARY STIRRUP BRACKET MOUNTED TO BUILDING (VERTICAL FACE)	20	28

LEGEND




A

NEW LED LUMINAIRE MOUNTED ON NEW GROUND PLANTED LIGHTING POLE (LETTER DENOTES PARTICULAR LUMINAIRE TYPE AND MOUNTING PARAMETERS AS PER THE LUMINAIRE AND POLE LIST)




D

NEW LED LUMINAIRES (2 OFF) MOUNTED ON NEW GROUND PLANTED LIGHTING POLE (LETTER DENOTES PARTICULAR LUMINAIRE TYPE AND MOUNTING PARAMETERS AS PER THE LUMINAIRE AND POLE LIST)




G

NEW LED FLOODLIGHT MOUNTED ON NEW FLANGE BASED LIGHTING POLE (LETTER DENOTES PARTICULAR LUMINAIRE TYPE AND MOUNTING PARAMETERS AS PER THE LUMINAIRE AND POLE LIST)




H

NEW LED FLOODLIGHTS (2 OFF) MOUNTED ON NEW FLANGE BASED LIGHTING POLE (LETTER DENOTES PARTICULAR LUMINAIRE TYPE AND MOUNTING PARAMETERS AS PER THE LUMINAIRE AND POLE LIST)



PROPOSED LIGHTING ISOLUX CONTOUR LINES



SPILL LIGHTING ISOLUX CONTOUR LINES (1 LUX AT MF = 1.0) (REFER SPILL LIGHT NOTES)

NOTES

- THE ACCESS ROAD LIGHTING HAS BEEN DESIGNED TO COMPLY WITH THE SUBCATEGORY PR5 REQUIREMENTS OF AS/NZS 1158.3.1:2020 (PEDESTRIAN AREA (CATEGORY P) LIGHTING - PERFORMANCE AND DESIGN REQUIREMENTS), AND THE CAR PARK LIGHTING HAS BEEN DESIGNED TO COMPLY WITH THE SUBCATEGORY PC3 REQUIREMENTS OF AS/NZS 1158.3.1:2020. REFER TO THE CALCULATION RESULTS SUMMARY TABLE. THE CALCULATIONS WERE COMPLETED WITHOUT ANY CONTRIBUTION FROM THE OUTDOOR WORK AREA LED FLOODLIGHTING.
- THE OUTDOOR OPERATIONAL AREAS (FREIGHT MARSHALLING YARDS, RAIL MOVEMENTS AND FREIGHT HANDLING AREAS) ARE DESIGNED TO COMPLY WITH THE RELEVANT LIGHTING REQUIREMENTS FROM TABLE 6.1 OF THE KIWIRAIL TRACTION AND ELECTRICAL STANDARD E-ST-EL-0131.
- THE ACCESS ROAD AND CAR PARK LUMINAIRES SHALL BE AEC ITALO LEDs WITH MODULES AND WATTAGES AS SPECIFIED IN THE LUMINAIRE AND POLE LIST. THE QUALITY OF MANUFACTURE AND OPTICAL PERFORMANCE OF ANY ALTERNATIVE LUMINAIRES SHALL MATCH OR EXCEED THAT OF THE ITALO (INCLUDING THE CURRENT DESIGN ILLUMINANCE LEVELS) AND SUPPORTING CALCULATIONS SHALL BE REQUIRED TO BE SUBMITTED ALONG WITH ANY ALTERNATIVE LUMINAIRES OFFERED.
- THE LED FLOODLIGHTS SHALL BE EWO R4 GENERATION 3 LED FLOODLIGHTS (OR EQUAL), SUPPLIED BY ENERGYLIGHT LTD. WITH OPTICS AND WATTAGES AS SPECIFIED IN THE LUMINAIRE AND POLE LIST. THE QUALITY OF MANUFACTURE AND OPTICAL PERFORMANCE OF ANY ALTERNATIVE LED FLOODLIGHTS SHALL MATCH OR EXCEED THAT OF THE EWO R4 (INCLUDING THE CURRENT DESIGN ILLUMINANCE LEVELS) AND SUPPORTING CALCULATIONS SHALL BE REQUIRED TO BE SUBMITTED ALONG WITH ANY ALTERNATIVE LUMINAIRES OFFERED.
- WHEN INSTALLED ALL NEW LUMINAIRES SHALL HAVE THE MOUNTING HEIGHTS AND TILT ANGLES AS SPECIFIED IN THE LUMINAIRE AND POLE LIST. THE NEW FLOODLIGHTING LUMINAIRES SHALL BE ATTACHED TO THE FRONT FACE OF THE LIGHTING POLE CROSS ARMS (1.2m LONG - SUPPLIED WITH THE LIGHTING POLES) IN ACCORDANCE WITH THE LED MANUFACTURES INSTRUCTIONS USING PROPRIETARY EWO R4 STANDARD STIRRUP BRACKETS (SUPPLIED WITH THE NEW LUMINAIRES). ALL LUMINAIRES SHALL BE AIMED IN ACCORDANCE WITH THE ORIENTATIONS DEPICTED ON THE LAYOUT DRAWINGS.
- A LIGHTING CONTROL SYSTEM SHALL BE SPECIFIED DURING DETAILED DESIGN, HOWEVER THE ACCESS ROAD AND CAR PARK LIGHTING SHALL BE CONTROLLED INDEPENDENTLY FROM THE OUTDOOR WORK AREA FLOODLIGHTS. THE OUTDOOR FLOODLIGHTS SHALL BE MANUALLY CONTROLLED FROM WITHIN EACH SPECIFIC WORK AREA. LOW LEVEL SECURITY LIGHTING SHALL BE PROVIDED FROM SELECTED ACCESS ROAD LIGHTS THAT WILL OPERATE DURING THE HOURS OF DARKNESS WHEN OPERATIONS HAVE STOPPED.
- THE COMPLETE LIGHTING UPGRADE REQUIRES NEW LED LUMINAIRES TO BE MOUNTED ONTO NEW LIGHTING POLES.
- ALL MATERIALS (INCLUDING LUMINAIRES, POLES, CROSS ARMS, BRACKETS AND MOUNTING HARDWARE) SHALL COMPLY WITH THE DURABILITY REQUIREMENTS OF KIWIRAIL.
- THIS DRAWING ONLY DEPICTS THE LUMINAIRES AND MOUNTING REQUIREMENTS ASSOCIATED WITH THE LIGHTING DESIGN. ANY WORK ASSOCIATED WITH PROVIDING POWER SUPPLY INFRASTRUCTURE (TO SUPPLY THE NEW LUMINAIRES) IS OUTSIDE THE SCOPE OF THIS DESIGN.
- THE CONTRACTOR SHALL BE RESPONSIBLE FOR ANY POWER SUPPLY DESIGN AND INSTALLATION (REQUIRED TO PROVIDE POWER AND CONTROLS TO THE NEW LIGHTING) AND SHALL PAY ANY ASSOCIATED LOCAL ELECTRICITY NETWORK FEES. THE CONTRACTOR SHALL COMPLY WITH THE ELECTRICITY (SAFETY) REGULATIONS, AS/NZS 3000 (NZ WIRING RULES) AND ANY SPECIFIC KIWIRAIL RULES AND PROCEDURES AS APPLICABLE.
- EACH NEW STEEL LIGHTING POLE SHALL BE EARTHED / BONDED TO THE FREIGHT HUB ELECTRICAL EARTHING SYSTEM IN ACCORDANCE WITH KIWIRAIL REQUIREMENTS.

SPILL LIGHT NOTES

- ACCORDING TO AS/NZS 4282:2019 (CONTROL OF THE OBTRUSIVE EFFECTS OF OUTDOOR LIGHTING) THE FREIGHT HUB IS WITHIN ZONE A2 (SPARSELY INHABITED RURAL / SEMI-RURAL AREAS WITH LOW DISTRICT BRIGHTNESS) WHERE THE VERTICAL ILLUMINATION (ON THE FRONT FACES OF RESIDENTIAL BUILDINGS CONTAINING WINDOWS) IS NOT PERMITTED TO EXCEED 1 LUX. TO ASSIST IN DETERMINING THE LIKELY AMOUNT OF SPILL LIGHT, ORIGINATING FROM THE FREIGHT HUB, THE 1 LUX HORIZONTAL ISOLUX CONTOUR LINES HAVE BEEN PLOTTED ON THE LAYOUT DRAWINGS.
- REFER TO FIG 210 FOR THE SPILL LIGHT CALCULATIONS AND FIG 211 FOR THE GLARE CALCULATIONS AT SPECIFIED RESIDENTIAL BUILDINGS.

REFERENCE DRAWINGS

- FIG: 201

LIGHTING LAYOUT SHEET 1 OF 8
- FIG: 202

LIGHTING LAYOUT SHEET 2 OF 8
- FIG: 203

LIGHTING LAYOUT SHEET 3 OF 8
- FIG: 204

LIGHTING LAYOUT SHEET 4 OF 8
- FIG: 205

LIGHTING LAYOUT SHEET 5 OF 8
- FIG: 206

LIGHTING LAYOUT SHEET 6 OF 8
- FIG: 207

LIGHTING LAYOUT SHEET 7 OF 8
- FIG: 208

LIGHTING LAYOUT SHEET 8 OF 8
- FIG: 209

LIGHTING POLE AND LUMINAIRE MOUNTING DETAILS
- FIG: 210

SPILL LIGHT CALCULATIONS
- FIG: 211

GLARE CALCULATIONS

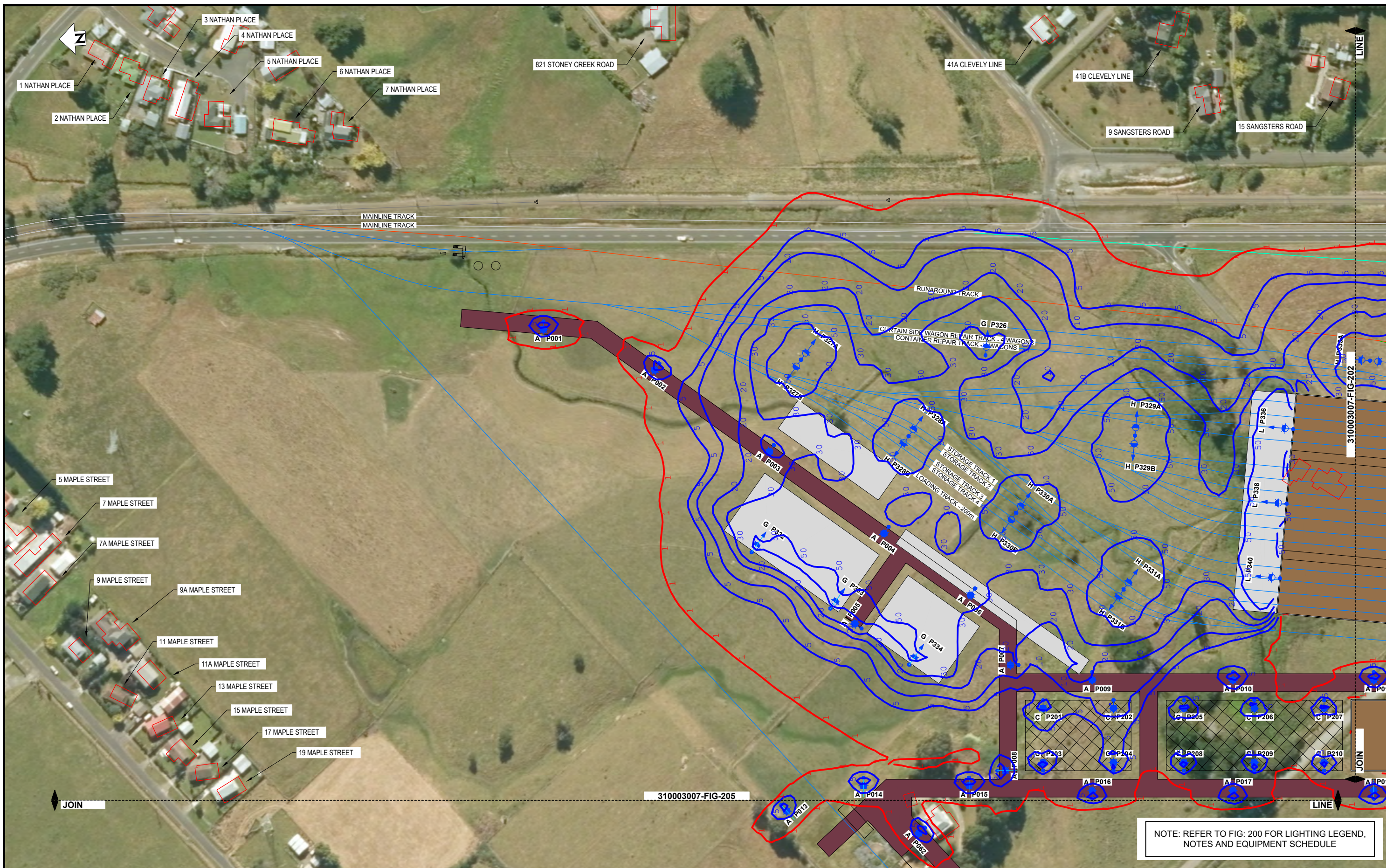
CALCULATION RESULTS - ACCESS ROADS AND CAR PARKS - ILLUMINANCE LEVELS AND UNIFORMITIES

Illuminance Calculation Summary Table - AS/NZS 1158.3.1:2020						
Label	CalcType	Units	Avg	Min	Max/Avg	Description
Access Roads	Illuminance	Lux	2.2	0.14	9.7	Cat PR5 - 0.85 Lux (Avg), 0.14 Lux (Min) and Uniformity (Max/Avg) of 10 (Max)
Container Terminal Car Park 1	Illuminance	Lux	3.8	0.8	3.1	Cat PC3 - 3.5 Lux (Avg), 0.7 Lux (Min) and Uniformity (Max/Avg) of 8 (Max)
Container Terminal Car Park 2	Illuminance	Lux	4.8	0.8	3.3	Cat PC3 - 3.5 Lux (Avg), 0.7 Lux (Min) and Uniformity (Max/Avg) of 8 (Max)
Container Terminal Car Park 3	Illuminance	Lux	3.8	0.9	4.0	Cat PC3 - 3.5 Lux (Avg), 0.7 Lux (Min) and Uniformity (Max/Avg) of 8 (Max)
Freight Forwarding Car Park	Illuminance	Lux	4.6	0.8	4.9	Cat PC3 - 3.5 Lux (Avg), 0.7 Lux (Min) and Uniformity (Max/Avg) of 8 (Max)
Network Services Car Park 1	Illuminance	Lux	3.9	0.9	3.1	Cat PC3 - 3.5 Lux (Avg), 0.7 Lux (Min) and Uniformity (Max/Avg) of 8 (Max)
Network Services Car Park 2	Illuminance	Lux	3.6	0.9	3.5	Cat PC3 - 3.5 Lux (Avg), 0.7 Lux (Min) and Uniformity (Max/Avg) of 8 (Max)
Network Services Car Park 3	Illuminance	Lux	3.5	0.7	3.4	Cat PC3 - 3.5 Lux (Avg), 0.7 Lux (Min) and Uniformity (Max/Avg) of 8 (Max)
Network Services Car Park 4	Illuminance	Lux	5.3	0.9	3.4	Cat PC3 - 3.5 Lux (Avg), 0.7 Lux (Min) and Uniformity (Max/Avg) of 8 (Max)
Network Services Car Park 5	Illuminance	Lux	4.6	0.8	3.8	Cat PC3 - 3.5 Lux (Avg), 0.7 Lux (Min) and Uniformity (Max/Avg) of 8 (Max)

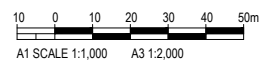
CALCULATION RESULTS - OUTDOOR OPERATIONAL AREAS - ILLUMINANCE LEVELS AND UNIFORMITIES

Illuminance Calculation Summary Table - KiwiRail Traction and Electrical Standard E-ST-EL-0131						
Label	CalcType	Units	Avg	Uo (Min/Avg)	Ud (Min/Max)	Design Requirements
Container Terminal Handling Area	Illuminance	Lux	39.4	0.4	0.2	Table 6.1 - Avg >= 30 Lux, Uo >= 0.4 and Ud >= 0.2
Freight Forwarding Area 1	Illuminance	Lux	33.2	0.4	0.2	Table 6.1 - Avg >= 30 Lux, Uo >= 0.4 and Ud >= 0.2
Freight Forwarding Area 2	Illuminance	Lux	32.2	0.4	0.3	Table 6.1 - Avg >= 30 Lux, Uo >= 0.4 and Ud >= 0.2
Log Loading Area and Tank Siding	Illuminance	Lux	37.1	0.4	0.2	Table 6.1 - Avg >= 30 Lux, Uo >= 0.4 and Ud >= 0.2
Network Services Handling Areas	Illuminance	Lux	37.2	0.4	0.3	Table 6.1 - Avg >= 30 Lux, Uo >= 0.4 and Ud >= 0.2
Railway Marshalling Areas	Illuminance	Lux	31.6	0.4	0.2	Table 6.1 - Avg >= 20 Lux, Uo >= 0.4 and Ud >= 0.2

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PLAN
SCALE 1:1,000



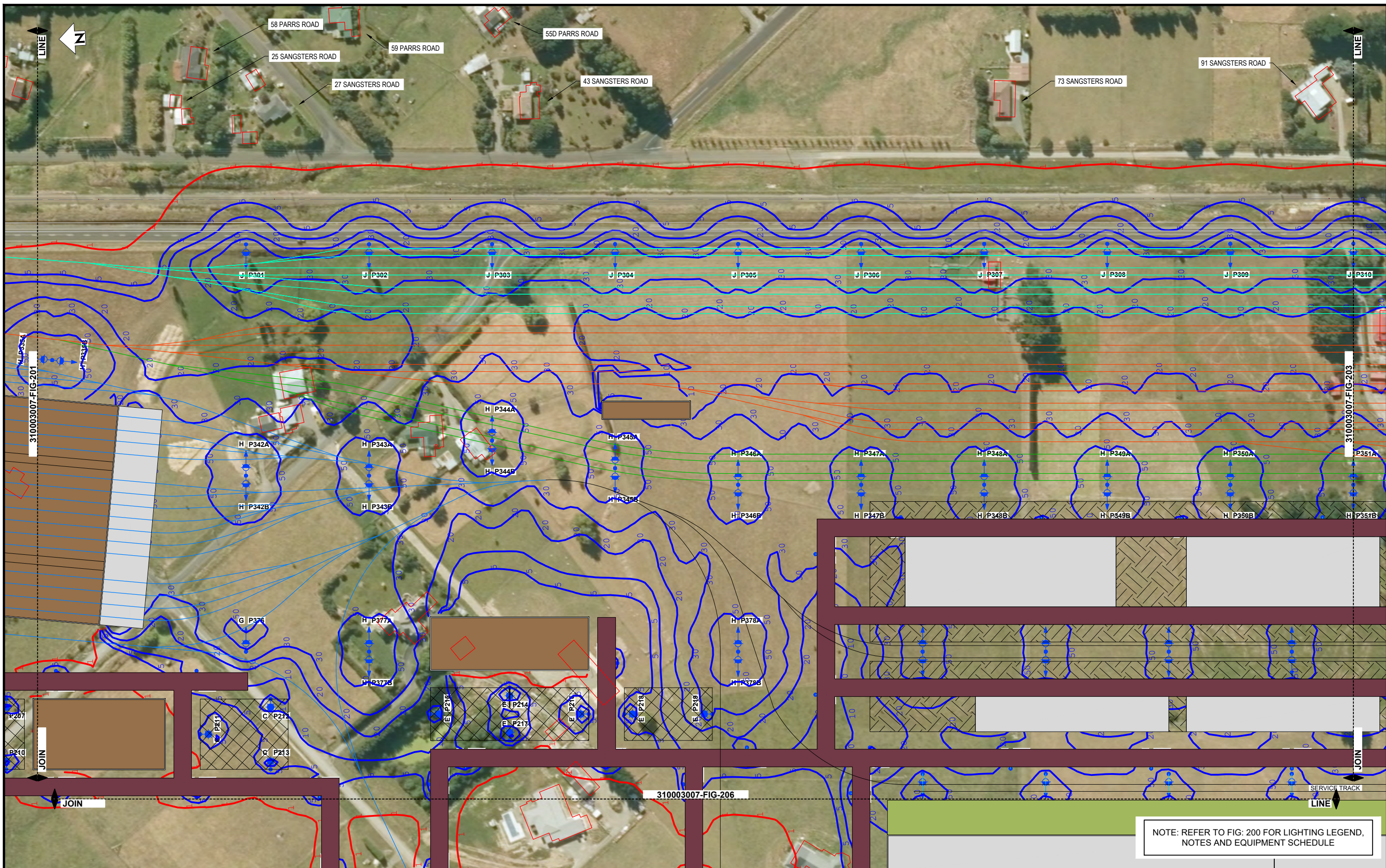
Job No: 310003007

KIWI RAIL HUB
SITE 3-G2 LIGHTING LAYOUT
SHEET 1 OF 8

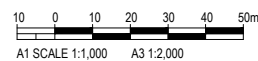
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Scale: 1:1000

FIG: 201

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PLAN
SCALE 1:1,000



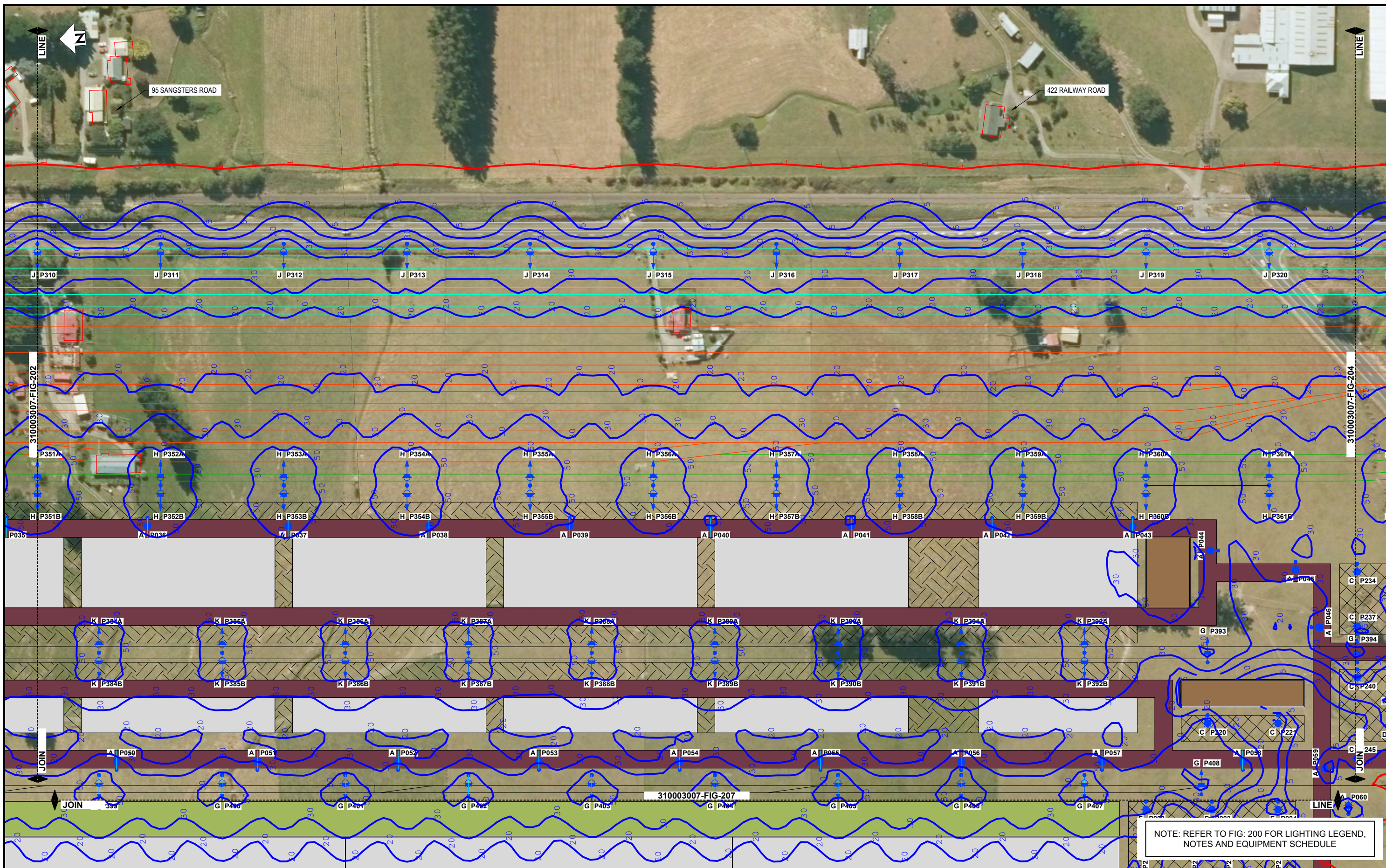
Job No: 310003007

KIWIRAIL HUB
SITE 3-G2 LIGHTING LAYOUT
SHEET 2 OF 8

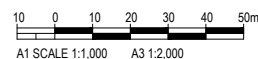
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Scale: 1:1000

FIG: 202

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PLAN
SCALE 1:1,000



Job No: 310003007

KIWI RAIL HUB
SITE 3-G2 LIGHTING LAYOUT
SHEET 3 OF 8

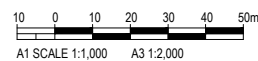
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Scale: 1:1000

FIG: 203

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PLAN
SCALE 1:1,000



Job No: 310003007

KIWI RAIL HUB
SITE 3-G2 LIGHTING LAYOUT
SHEET 4 OF 8

Drawn By: IAN CAMPBELL
Scale: 1,1000

FIG: 204

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PLAN
SCALE 1:1,000

10 0 10 20 30 40 50m
A1 SCALE 1:1,000 A3 1:2,000



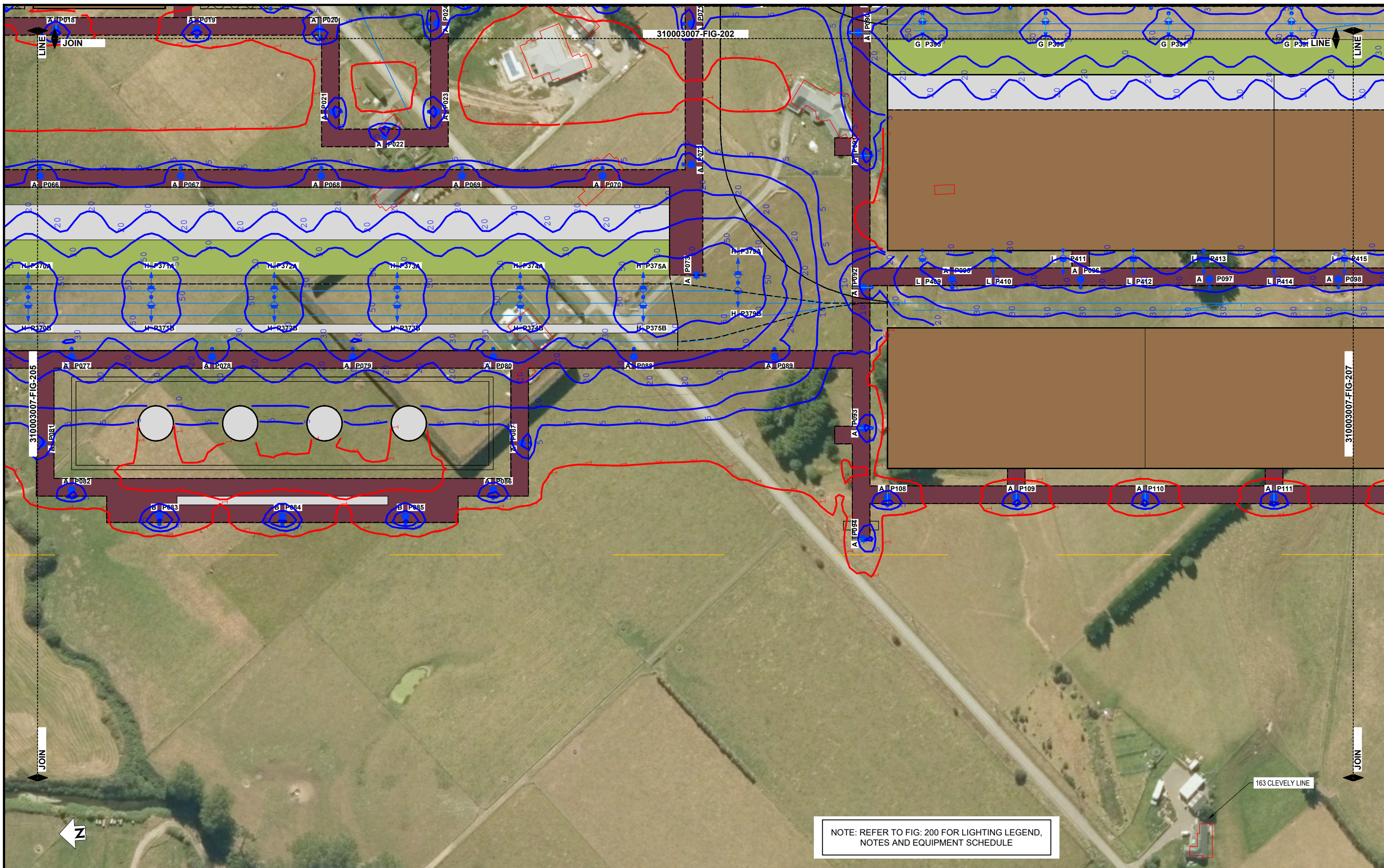
Job No: 310003007

KIWRIL HUB
SITE 3-G2 LIGHTING LAYOUT
SHEET 5 OF 8

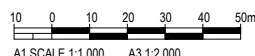
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FIG: 205

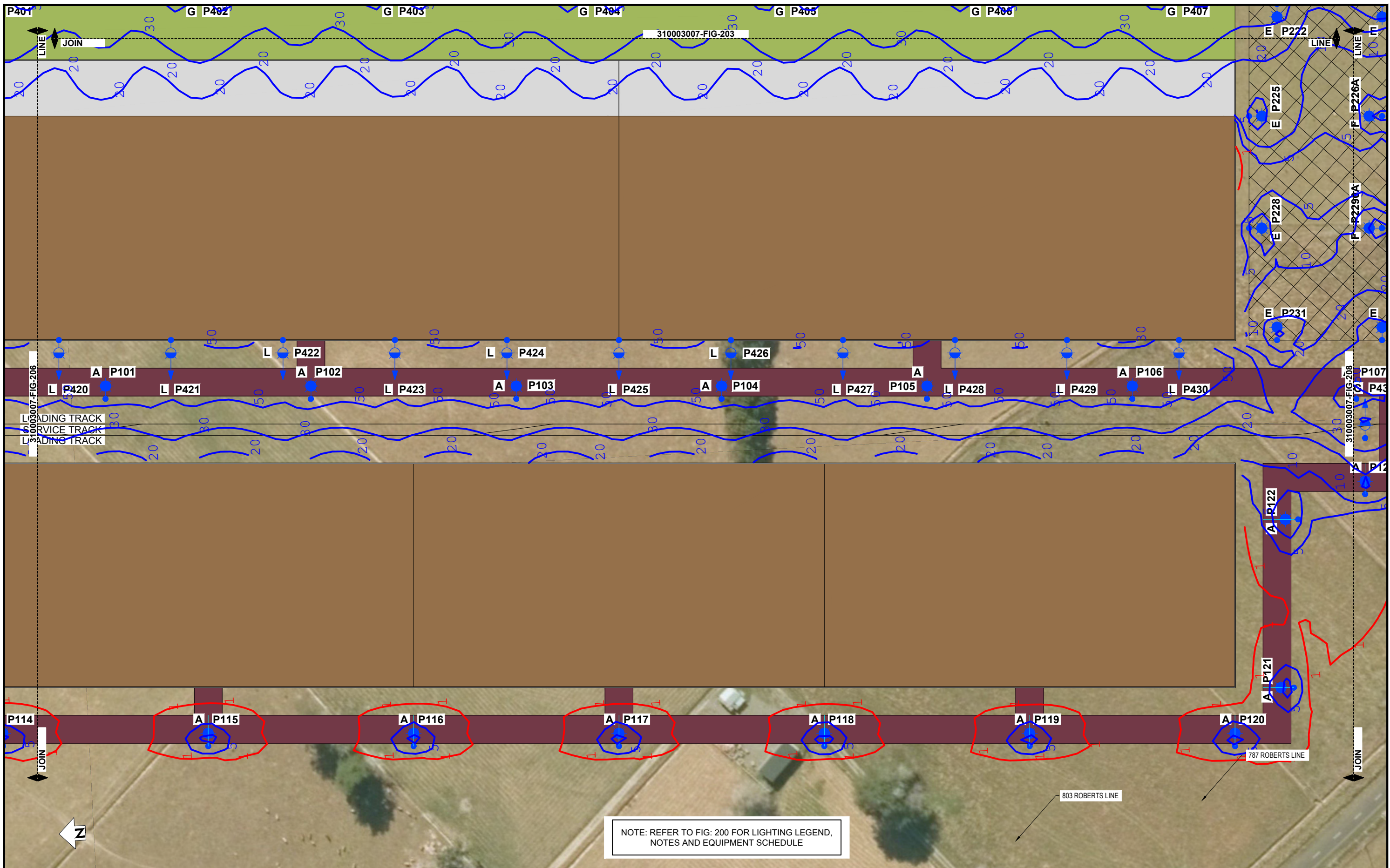
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PLAN
SCALE 1:1,000



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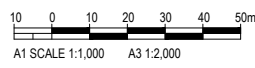


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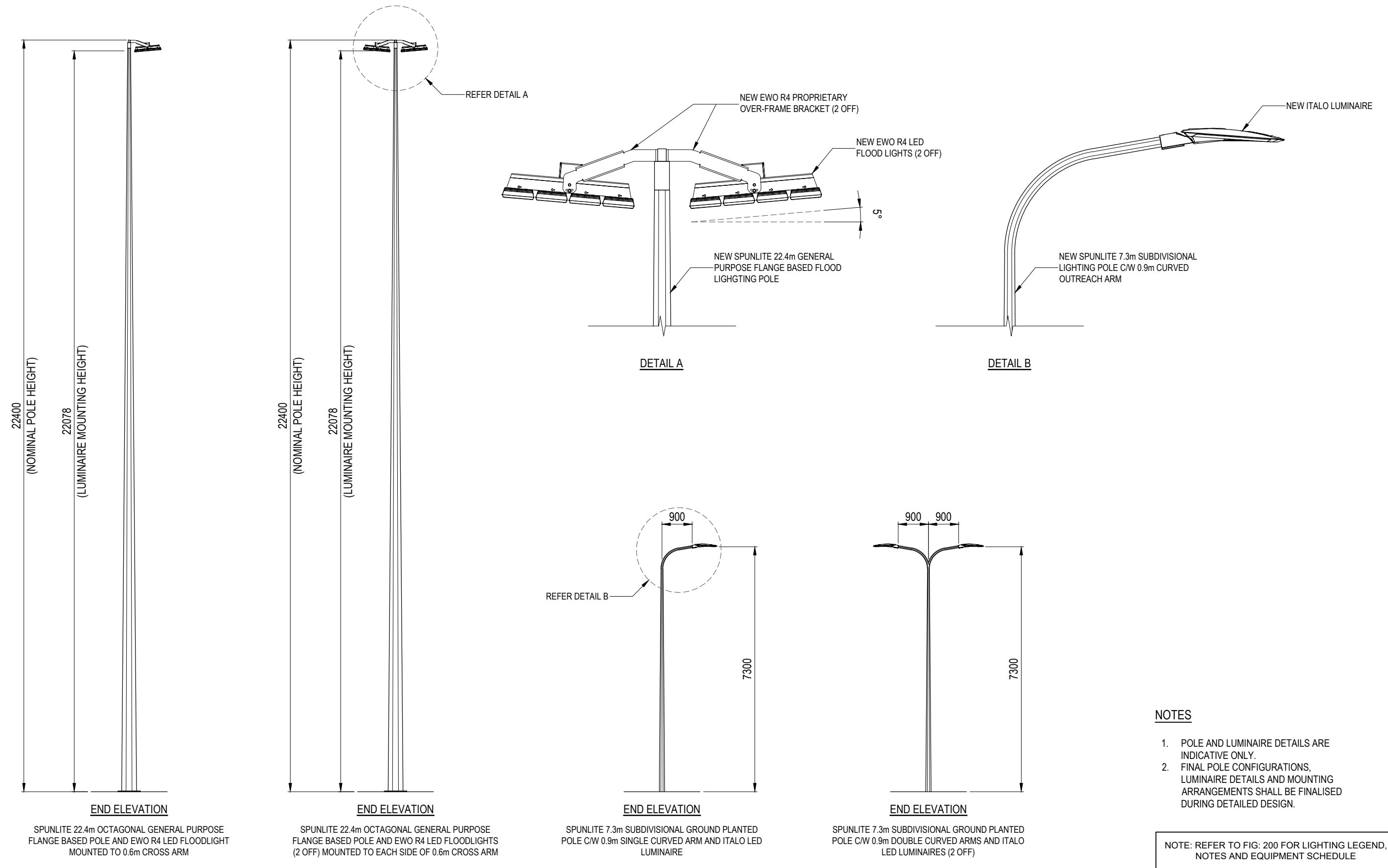


NOTE: REFER TO FIG: 200 FOR LIGHTING LEGEND, NOTES AND EQUIPMENT SCHEDULE

PLAN
SCALE 1:1,000



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Job No: 310003007

